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(54) FLAME RETARDANT MULTILAYERED FILM AND FLAT CABLE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To prepare the subject film having excellent adhesiveness and electric insulating property, and being imparted with excellent flame retardant property and useful for a flat cable by making a film base material and/or an adhesive agent layer flameproof with a flame retardant.

SOLUTION: This flame retardant multiplayered film has (A) an adhesive agent layer composed of a thermoplastic polyester-based resin having thermal bonding property on (B) a film base material composed of a thermoplastic polyester-based resin and the base material and/or the adhesive agent layer is made to be flameproof with a flame retardant. Preferably, the adhesive agent layer of the component A is composed of a composition comprising at least one kind of polyester-based resin selected from (i) a polyester-based resin containing dicarboxylic acid components and glycol components as constituting components and obtained by copolymerizing more than total three kinds of components and (ii) a polyester-based resin obtained by copolymerizing respective one kind of a dicarboxylic acid component with a glycol component as constituting components and having  $\leq 10\%$  crystallinity after melt extrusion molding, and a thermoplastic polyester-based elastomer.

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**CLAIMS**

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[Claim(s)]

[Claim 1] The fire-resistant multilayer film which is a fire-resistant adhesive property film with which the adhesives layer which consists of thermoplastic polyester system resin (b) which has thermal melting arrival nature was formed on the film base material which consists of thermoplastic polyester system resin (a), and is characterized by flameproofing of the above-mentioned base material and/or the adhesives layer being carried out by the flame retarder.

[Claim 2] The fire-resistant multilayer film characterized by being formed from the constituent with which an adhesives layer according to claim 1 consists of one or more sorts of polyester system resin (b-1) chosen from the group which consists of the following (\*\*\*) and (\*\*\*), and a thermoplastic polyester system elastomer (b-2).

(b) Polyester system resin obtained by copolymerizing a total of three or more sorts of components which make a dicarboxylic acid component and a glycol component a constituent, and are chosen from a dicarboxylic acid component and a glycol component.

(b) Polyester system resin whose degree of crystallinity after melting extrusion molding of a dicarboxylic acid component and a glycol component obtained by copolymerizing one sort as a constituent, respectively is 10% or less.

[Claim 3] The fire-resistant multilayer film according to claim 1 or 2 characterized by being formed from the constituent with which a base material consists of a polybutylene terephthalate independent or polybutylene terephthalate, and a thermoplastic polyester system elastomer (a-1).

[Claim 4] A fire-resistant multilayer film given in any 1 term of claims 1-3 characterized by being formed from the film with which a base material consists of thermoplastic polyester system resin (a) with which waterproof processing was performed.

[Claim 5] A fire-resistant multilayer film given in any 1 term of claims 1-4 to which a base material and/or an adhesives layer are characterized by carrying out flameproofing by the phosphorus series flame retardant.

[Claim 6] The flat cable which thermal melting arrival is carried out so that the binder layers of the fire-resistant multilayer film of a publication may counter any 1 term of claims 1-5, and is characterized by putting the conductor in which the circuit pattern was formed among both binder layers.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the flat cable which used a fire-resistant multilayer film and it.

[0002]

[Description of the Prior Art] The flat cable with which the cross section covered with electric insulation resin conventionally the conductor which has two or more flat circuit patterns in the shape of sandwiches from both sides in the mounting technology of an electric wire is used widely because of the increase in efficiency of a wiring activity. Such a flat cable is indicated by JP,5-282922,A, it is lightweight, and since installation is easy, especially in the auto industry, the adoption is considered for the increase in efficiency of a wiring activity, or lightweight-izing of a car body.

[0003] In recent years, although the application of a flat cable is various, fire retardancy has come to be required when using it for an electrical machinery and apparatus member, an automotive application, etc. especially. As the flameproofing approach of a flat cable, the adhesives layer side of the adhesive film of two sheets in which the adhesives layer containing a flame retarder was formed on the base material is made to counter, and the approach of putting and sealing the conductor which has a circuit pattern between adhesives layers is indicated, for example as indicated by JP,5-303918,A.

[0004] However, the adhesive strength of an adhesives layer not only declines by addition of a flame retarder, but by this approach, in order to hold the adhesive strength between an adhesives layer and a base material, priming was needed separately on the base material, and there was a trouble that a production process became complicated.

[0005] In the above-mentioned flat cable, when polyester resin and the polyester resin in which thermal melting arrival is possible as an adhesives layer were used as a base material layer and it was used in the humid location since the water resisting property of polyester resin was inferior, there was a trouble that the dynamic physical properties of a base material and the adhesive strength of an adhesives layer declined.

[0006]

[Problem(s) to be Solved by the Invention] This invention is made in view of the above-mentioned trouble, and the object is in offering the fire-resistant multilayer film with which the outstanding fire retardancy was given, and the flat cable using it while an adhesive property and electric insulation are excellent.

[0007]

[Means for Solving the Problem] The fire-resistant multilayer film of this invention is a fire-resistant adhesive property film with which the adhesives layer which consists of thermoplastic polyester system resin (b) which has thermal melting arrival nature was formed on the film base material which consists of thermoplastic polyester system resin (a), and is characterized by flameproofing of the above-mentioned base material and/or the adhesives layer being carried out by the flame retarder.

[0008] The base material used by this invention is formed from thermoplastic polyester system resin (a). as the above-mentioned thermoplastic polyester system resin (a), copolymers, such as polymer; Pori (ethylene isophthalate-terephthalate), such as polyethylene terephthalate, polypropylene terephthalate, polybutylene terephthalate, poly hexylene terephthalate, polyethylenenaphthalate, polybutylene naphthalate, polyethylene -1, the 2-screw (phenoxy ethane) -4, and a 4'-dicarboxy rate, Pori (butylene terephthalate-isophthalate), and Pori (butylene terephthalate-Deccan dicarboxy rate), are mentioned, for example.

[0009] The adhesives layer used by this invention is formed from the thermoplastic polyester system resin (b) which has thermal melting arrival nature.

[0010] As thermoplastic polyester system resin (b) which has the above-mentioned thermal melting arrival

nature For example, the same polyethylene terephthalate as thermoplastic polyester system resin (a), Polypropylene terephthalate, polybutylene terephthalate, poly hexylene terephthalate, Polymers, such as polyethylenenaphthalate, polybutylene naphthalate, polyethylene -1, the 2-screw (phenoxy ethane) -4, and a 4'-dicarboxy rate; Pori (ethylene isophthalate-terephthalate), Copolymers, such as Pori (butylene terephthalate-isophthalate) and Pori (butylene terephthalate-Deccan dicarboxy rate), are mentioned.

[0011] Moreover, the water resisting property of an adhesives layer can be raised by mixing thermoplastic polyolefine system resin (c) to the thermoplastic polyester system resin (b) which has the above-mentioned thermal melting arrival nature, and forming an adhesives layer in it.

[0012] As the above-mentioned thermoplastic polyolefine system resin (c), a polypropylene resin, polyethylene system resin, polybutene system resin, an ethylene-glycidyl methacrylate copolymer, an ethylene-ECHIERU acrylate base maleic-anhydride graft copolymer, etc. are mentioned, for example.

[0013] Since the adhesive property at the time of thermal melting arrival is good for especially the above-mentioned adhesives layer, it is desirable to use the following polyester system resin (b-1) as thermoplastic polyester system resin (b). Moreover, the above-mentioned adhesives layer may be formed from the constituent which consists of the above-mentioned polyester system resin (b-1) and a following thermoplastic polyester system elastomer (b-2).

[0014] As the above-mentioned polyester system resin (b-1), at least one sort chosen from the following (b) and (b) is mentioned.

(b) Polyester system resin obtained by copolymerizing a total of three or more sorts of components which make a dicarboxylic acid component and a glycol component a constituent, and are chosen from a dicarboxylic acid component and a glycol component. As such a dicarboxylic acid component and a glycol component, the following combination of i-iii is mentioned, for example.

i) Glycol component of +two or more sorts of dicarboxylic acid components [ one sort of ].

ii) Glycol component of +one sort of dicarboxylic acid components [ two or more sorts of ].

iii) Glycol component of +two or more sorts of dicarboxylic acid components [ two or more sorts of ].

By such polyester system resin, especially the degree of crystallinity after melting extrusion molding is not limited.

[0015] (b) Polyester system resin whose degree of crystallinity after melting extrusion molding of a dicarboxylic acid component and a glycol component obtained by copolymerization by making one sort into a constituent, respectively is 10% or less. Since it has the inclination for thermal melting arrival nature to fall when it exceeds 10%, the above-mentioned degree of crystallinity is restricted to 10% or less, and as it is low, it is more desirable. Although the above-mentioned degree of crystallinity can be measured by the well-known approach, it is X wire method preferably.

[0016] Although the carboxylic-acid component and diol component which are used from the former are mentioned as a monomer component which constitutes the polyester system resin (b-1) equivalent to the above-mentioned (\*\*) and (\*\*), preferably, a main carboxylic-acid component is a terephthalic acid, and a main diol component is ethylene glycol or 1, and 4-tetramethylene glycol. Moreover, as other constituents, isophthalic acid, diethylene-glycol, 1, and 4-cyclohexane dimethanol is desirable.

[0017] 2.5-25-mol% of all the monomer components of the rate of the constituent of others in the above-mentioned polyester system resin (b-1) are desirable, and it is 10-15-mol % more preferably.

[0018] The above-mentioned polyester system resin (b-1) is obtained by copolymerizing the combination (\*\*,\*\*) of for example, the following component.

\*\* Terephthalic-acid + ethylene glycol +1, 4-cyclohexane dimethanol \*\* terephthalic-acid + ethylene glycol + diethylene-glycol \*\* terephthalic-acid + isophthalic acid + ethylene glycol, \*\* terephthalic-acid + isophthalic acid +1, 4-cyclohexane dimethanol \*\* terephthalic-acid + isophthalic acid + propylene glycol \*\* terephthalic-acid + isophthalic acid + ethylene glycol + propylene glycol [0019] Moreover, as a

thermoplastic polyester system elastomer (b-2), although the polycondensation object of a polyester component and flexible components, such as a polyether and a polysiloxane, is mentioned, it is desirable to use especially the polyether ester system elastomer which is the polycondensation object of the above-mentioned polyester system resin (b-1) and a polyether.

[0020] Although especially the melting point of the above-mentioned thermoplastic polyester system elastomer (b-2) is not limited, it is that is desirable and it is not more preferably higher than 70 degrees C that it is not higher than the heat-sealing initiation temperature (seal pressure: conditions for 2kg/cm<sup>2</sup>, and seal time amount:1 second) of the monolayer film which consists of polyester system resin used for an adhesives layer 100 degrees C or more. When the reason heat seals the adhesives layer formed from the constituent of polyester system resin (b-1) and a polyether-ester system elastomer, it is because not only

polyester system resin (b-1) but a polyether-ester system elastomer can be fused, can flow and it can participate in adhesion.

[0021] The inside of mixture with the above-mentioned polyester system resin (b-1) and a thermoplastic polyester system elastomer (b-2), Since a chip and a possibility of having an adverse effect on a moldability and producing turbulence in a layer have the multilayer film which will be obtained if the rate of a polyester system elastomer (b-2) decreases in tough nature when it increases the polyester system resin (b-1) 100 weight section -- receiving -- below the 150 weight sections -- desirable -- more -- desirable -- the 10 - 150 weight section -- it is 20 - 50 weight section still more preferably.

[0022] When using polyolefine system resin (c) in order to deck-watertight-luminaire-ize the above-mentioned adhesives layer, among the mixture of polyester system resin (b-1) and a thermoplastic polyester system elastomer (b-2), more than the 100 weight sections of the rate of polyolefine system resin (c) are desirable to the this mixture [(c)+(b-1)+(b-2)] 100 weight section, and it is more than the 200 weight sections more preferably.

[0023] Moreover, the point of workability, thermal resistance, and dimensional stability to polybutylene terephthalate (henceforth PBT) is desirable also in the above-mentioned thermoplastic polyester system resin (a) as a base material used by this invention. It is thermoplastic polyester system resin which Above PBT uses 1,4-butanediol and a terephthalic acid as a principal component, and is obtained according to a polycondensation, and is the range which does not spoil the property of PBT original, and diol components other than 1,4-butanediol and dicarboxylic acid components other than a terephthalic acid may be used as a monomer component.

[0024] As diol components other than the above-mentioned 1,4-butanediol, ethylene glycol, diethylene-glycol, neopentyl glycol, 1, and 4-cyclohexane dimethanol etc. is mentioned. Moreover, as dicarboxylic acid components other than the above-mentioned terephthalic acid, isophthalic acid, a sebacic acid, an adipic acid, an azelaic acid, a succinic acid, etc. are mentioned.

[0025] Moreover, since it will become easy to fracture Above PBT when the film obtained is bent if intrinsic viscosity (I. V.) becomes low, it is desirable that the intrinsic viscosity in the inside of 25-degree C o-chlorophenol is at least 0.6 or more.

[0026] Above PBT may be used as mixture with a thermoplastic polyester system elastomer (a-1). As such a thermoplastic polyester system elastomer (a-1), although the polycondensation object of a polyester component and flexible components, such as a polyether and a polysiloxane, is mentioned, it is desirable to use especially the polyether ester system elastomer which is the polycondensation object of the following polyester system resin (a-2) and a polyether.

[0027] The same component as what is used by the polyester system resin (b-1) mentioned above as the above-mentioned polyester system resin (a-2) is used suitably.

[0028] In addition, it is more desirable than the thermoplastic polyester system resin (b) and the thermoplastic polyolefine system resin (c) which have the thermal melting arrival nature used in the below-mentioned adhesives layer as the above-mentioned thermoplastic polyester system resin (a) to use what has a glass transition temperature high 10 degrees C or more. Although measurement of the above-mentioned glass transition temperature can be measured by the well-known approach, it is a scanning differential method (DSC) preferably.

[0029] As the above-mentioned base material, when the mixture of PBT and a thermoplastic polyester system elastomer (a-1) is used, the rate of the thermoplastic polyester system elastomer in this mixture (a-1) has the desirable 10 - 300 weight section to the PBT100 weight section.

[0030] In this invention, flameproofing of the above-mentioned base material and/or the adhesives layer is carried out by the flame retarder. As a flame retarder used, although a halogen series flame retardant, a phosphorus series flame retardant, etc. are mentioned, the activity of the phosphorus series flame retardant which does not generate gas harmful at the time of combustion is more desirable.

[0031] As the above-mentioned halogen series flame retardant, a thing with a decomposition temperature of 250 degrees C or more is desirable on the relation of the molding temperature of the thermoplastic polyester system resin (a) which constitutes a base material, and the thing of 20 % of the weight or more of halogen contents is still more desirable. Decomposition temperature means the temperature at the time of 5-% of the weight reduction by thermogravimetric analysis here.

[0032] As the above-mentioned halogen series flame retardant, for example A park ROROPENTA cyclo decane, Hexabromobenzene, a pen tableau mottle en, hexabromobiphenyl, A deca BUROMO biphenyl, a hexa BUROMO cyclo decane, decabromodiphenyl ether, Octabromodiphenyl ether, hexa BUROMO diphenyl ether, Screw (pen TABUROMO phenoxy) ethane, ethylene screw - (tetrabromo phthalimide),

Low-molecular bromine content compounds, such as tetrabromobisphenol A; A bromination polycarbonate, A bromination epoxy compound, a bromination phenoxy compound, Pori (bromination benzyl acrylate), Polymers, oligomer, etc. which were halogenated, such as bromination polyphenylene ether, bromination bisphenol A / chlorination cyanuric / bromination phenol condensate, and bromination polystyrene, are mentioned, these may be used independently and two or more sorts may be used together.

[0033] Since the physical properties and bond strength of a base material will fall if sufficient fire retardancy cannot be given if it decreases, but it increases, the loadings of the above-mentioned halogen series flame retardant have desirable 1 - 60 weight section to the thermoplastic polyester system resin 100 weight section, and are 5 - 30 weight section more preferably.

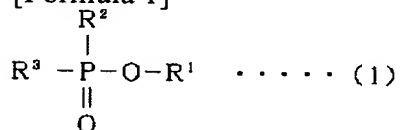
[0034] Antimony oxide, such as an antimony trioxide and antimony pentoxide, may be used together as a fire-resistant assistant by the above-mentioned halogen series flame retardant. The loadings of the above-mentioned fire-resistant assistant have desirable 1 - 30 weight section to the thermoplastic polyester system resin 100 weight section used for a base material or an adhesives layer, and are 3 - 20 weight section more preferably. It is desirable to add especially at a rate of per 2-5 halogen atoms of a halogen series flame retardant and one antimony atom.

[0035] As the above-mentioned phosphorus series flame retardant, the Lynn content compound and/or ammonium polyphosphate are mentioned.

[0036] As the above-mentioned Lynn content compound, what is expressed with a general formula (1) is used.

[0037]

[Formula 1]



[0038] The inside of a formula, and R1 They are a hydrogen atom, the shape of a straight chain of carbon numbers 1-16, a letter alkyl group of branching, or the aryl group of carbon numbers 6-16 R2 They are a hydrogen atom, the shape of a straight chain of carbon numbers 1-16, the letter alkyl group of branching, an alkoxy group, the aryl group of carbon numbers 6-16, or an aryloxy radical R3 A hydrogen atom, the shape of a straight chain of carbon numbers 1-16, the letter alkyl group of branching, or the aryl group of carbon numbers 6-16 is shown, respectively.

[0039] the phosphorus compounds expressed with the above-mentioned general formula (1) -- carrying out - - For example, methylphosphonic acid, methylphosphonic acid dimethyl, methylphosphonic acid diethyl, Ethyl phosphonic acid, propyl phosphonic acid, butyl phosphonic acid, 2-methylpropyl phosphonic acid, t-butyl phosphonic acid, 2, 3-dimethyl butyl phosphonic acid, octyl phosphonic acid, Phenylphosphonic acid, dioctyl phenyl phosphonate, dimethyl phosphinic acid, Methylethyl phosphinic acid, methylpropyl phosphinic acid, diethyl phosphinic acid, Dioctyl phosphinic acid, phenyl phosphinic acid, diethyl phenyl phosphinic acid, a diphenylphosphine acid, screw (4-methoxyphenyl) phosphinic acid, etc. are mentioned, and even if these are used independently, two or more sorts may be used together.

[0040] As the above-mentioned ammonium polyphosphate, it is a general formula  $(\text{NH}_4 \text{PO}_3)_n$ . The easy flow expressed is powdered and a poorly soluble thing is desirable in water. Moreover, the thing of n of 10-1000 is desirable from the point of the dispersibility to polyester system resin among a formula.

[0041] Since the various physical properties of a base material or an adhesives layer will fall if sufficient fire retardancy cannot be given if it decreases, but it increases, the loadings of the above-mentioned phosphorus series flame retardant have the desirable 5 - 200 weight section to the pitch 100 weight section used for a base material or an adhesives layer.

[0042] A fire-resistant assistant and a carbonization accelerator may be used together by the above-mentioned phosphorus series flame retardant if needed. As the above-mentioned fire-resistant assistant, the mineral salt of inorganic oxides, such as a silicon dioxide, a calcium carbonate, etc. is mentioned, and carbon black etc. is mentioned as the above-mentioned carbonization accelerator. These fire-resistant assistants and carbonization accelerators may be used independently, and two or more sorts may be used together.

[0043] When it decreases, the fire-resistant improvement effectiveness is not acquired, but since the various properties of a base material or an adhesives layer will fall if it increases, 0.5 - 20 weight section is desirable [ the loadings of the above-mentioned fire-resistant assistant and/or a carbonization accelerator ] to the pitch



100 weight section used for a base material or an adhesives layer.

[0044] Other additives may be added by the base material and/or adhesives layer by which flameproofing processing was carried out [ above-mentioned ] if needed.

[0045] When a water resisting property is required of the above-mentioned base material, waterproof processing is performed to thermoplastic polyester system resin (a). Although not limited, especially as a waterproof art, to thermoplastic polyester system resin (a), for example as a (I) water resisting property grant component As an approach:(II) water resisting property grant component which adds one or more sorts chosen from phosphorus compounds, a diene compound, and an oxetane compound The approach of adding combining one or more sorts chosen from an ethylene alkyl acrylate copolymer and a thermoplastic polyester elastomer and the poly carbodiimide which has at least two carbodiimide radicals in intramolecular etc. is mentioned.

[0046] As a waterproof art, when the approach of the above (I) is adopted, since physical properties, such as elongation of a base material film, will fall if sufficient water resisting property is not given but it increases if it decreases, the 1 - 100 weight section is desirable [ the addition of a waterproof grant component ] to the thermoplastic polyester system (resin a) 100 weight section.

[0047] Moreover, as a waterproof art, when the approach of the above (II) is adopted, as for the addition of a waterproof grant component, it is desirable that being chosen out of an ethylene alkyl acrylate copolymer and a thermoplastic polyester elastomer to the thermoplastic polyester system (resin a) 100 weight section for the same reason as the above (I) doubles and uses [ which constructs one or more sorts of 1 - 50 weight sections, and the poly carbodiimide 0.1 - 10 weight sections ].

[0048] Moreover, an antioxidant may be added by the thermoplastic polyester system resin (a) used for a base material, in order to prevent oxidation degradation and to prevent lowering of a mechanical strength, while preventing the desperation of the resin at the time of a fabricating operation and making the appearance of a Plastic solid good.

[0049] As the above-mentioned anti-oxidant, 2,6-di-t-butyl-p-cresol, Butyl-ized hydroxyanisole, 2,6-di-t-butyl-4-ethylphenol, Stearyl-beta-(3, 5-G t-butyl-4-hydroxyphenyl) propionate, 2 and 2'-methylenebis (4-methyl-6-t-butylphenol), 2 and 2'-methylenebis (4-ethyl-6-t-butylphenol), - thio screw (3-methyl-6-t-butylphenol), and 4 and 4' 4, 4'-butylidenebis (3-methyl-6-t-butylphenol), Tetrakis [methylene-3-(3', 5'-G t-butyl-4-hydroxyphenyl) propionate] methane, Phenol system compounds, such as 1, 1, and 3-tris (2-methyl-4-hydroxy-5-t-buthylphenyl) butane; A phenyl-beta-naphthylamine, Amine system compounds, such as N and N'-diphenyl-p-phenylene diamine; Tris (nonylphenyl) phosphite, The Lynn system compounds, such as triphenyl phosphite, trio KUTADE sill phosphite, and diphenyl isodecyl phosphite; Dilauryl thiodipropionate, Sulfur compounds, such as dimyristyl thiodipropionate and distearyl thiodipropionate, etc. are mentioned, these may be used independently and two or more sorts may be used together.

[0050] Since sufficient effectiveness is not acquired, and the effectiveness beyond it will not be acquired even if it increases more than a constant rate if it decreases, below 2 weight sections of the addition of the above-mentioned antioxidant are desirable to the thermoplastic polyester system (resin a) 100 weight section, and it is 0.1 - 1 weight section more preferably.

[0051] An ultraviolet ray absorbent besides a glass fiber and an inorganic bulking agent, an antistatic agent, lubricant, a release agent, a pigment, etc. may be further added by the above-mentioned base material if needed.

[0052] The fire-resistant multilayer film of this invention uses a thermoplastic polyester system resin (a) film as a base material, and the adhesives layer which has thermal melting arrival nature is formed in one side or both sides of this base material.

[0053] The above-mentioned fire-resistant multilayer film can be conventionally manufactured by well-known approaches, such as for example, the co-extruding method and an extrusion lamination process.

[0054] By the above-mentioned co-extruding method, using two or more sets of extruders, resin the same or of a different kind can be joined by the inside of a feed block and a die, or opening of a die in the state of melting, and the multilayer film with which the adhesives layer was formed on the base material can usually be manufactured at one process. Since both the resin which forms an adhesives layer, and each resin which forms a base material are thermoplastic polyester system resin when obtaining a multilayer film, even if compatibility is high and uses neither a primer nor adhesive resin by this approach, the multilayer film excellent in the adhesive property between layers can be obtained.

[0055] Moreover, after applying the thermoplastic polyolefine system resin (c) which has the thermoplastic polyester system resin (b) and/or thermal melting arrival nature which have the thermal melting arrival nature breathed out from the extruder, cooling and forming an adhesives layer on a base material in the

above-mentioned extrusion lamination process on the thermoplastic polyester system (resin a) film used as a base material, a multilayer film can be obtained by carrying out an adhesives layer thermal melting arrival, and carrying out a laminating.

[0056] Although the thickness of the above-mentioned multilayer film is chosen as arbitration by the application, since sufficient flexibility will no longer be acquired if base material reinforcement will fall if it becomes small, and it becomes large, the thickness ratio (base material thickness / adhesives thickness) of a base material and an adhesives layer has the desirable range of 0.01-1000.

[0057] The fire-resistant flat cable of this invention makes the adhesives layers of the above-mentioned fire-resistant multilayer film counter, and is obtained by putting the conductor in which the circuit pattern was formed between the adhesives layers of these both, and carrying out a laminating by thermal melting arrival.

[0058] By carrying out the laminating of two or more fire-resistant flat cables, the fire-resistant flat cable of this invention may be used as multilayer structure into which the conductor in which the circuit pattern was formed was built in three dimensions, may carry out the laminating of the aluminum foil to the front face of the above-mentioned fire-resistant flat cable, and may give electromagnetic wave shielding to it. For this reason, what prepared the adhesives layer in both sides may be used as a base material of a fire-resistant flat cable, using adhesives, the laminating of the front faces of a fire-resistant flat cable may be carried out, or the laminating of the aluminum foil may be carried out.

[0059]

[Embodiment of the Invention] Hereafter, although an example explains this invention concretely, this invention is not limited to this.

[0060] In the following examples and examples of a comparison, following thermoplastic polyester system resin and a following thermoplastic polyester system elastomer are used.

[Manufacture of thermoplastic polyester system resin (A-1)] Copolymerization of 50 mol % of terephthalic acids, ethylene glycol 35mol%, and 1 and the 4-cyclohexane dimethanol 15mol% was carried out, and polyester system resin (A-1) [melting point nothing and 83 degrees C of glass transition points] was manufactured.

[0061] [Manufacture of thermoplastic polyester system resin (A-2)] Copolymerization of 40 mol % and ten mol [ of isophthalic acid ] % of terephthalic acids and the butylene-glycol 50mol% was carried out, and polyester system resin (A-2) [the melting point of 162 degrees C, 59 degrees C of glass transition points, and intrinsic viscosity 0.76] was manufactured.

[0062] [Manufacture of thermoplastic polyester system resin (A-3)] Copolymerization of 40 mol % and ten mol [ of isophthalic acid ] % of terephthalic acids and the ethylene glycol 50mol% was carried out, and polyester system resin (A-3) [the melting point of 150 degrees C and 57 degrees C of glass transition points] was manufactured.

[0063] [Manufacture of a thermoplastic polyester system elastomer] Copolymerization of a terephthalic acid, isophthalic acid, a butylene glycol, and the polytetramethylene glycol was carried out, and the polyester system elastomer of the melting point of 155 degrees C and 0 degree C of glass transition points was obtained.

[0064] (Examples 1-9 and examples 1 and 2 of a comparison) The resin constituent for base materials of the loadings shown in tables 1 and 2 and the resin constituent for adhesives of the loadings shown in tables 1 and 2 were co-extruded, on the base material of 100-micrometer thickness formed from the resin constituent for base materials, the laminating of the adhesives layer of 20-micrometer thickness was carried out, and the fire-resistant multilayer film was obtained. Subsequently, the adhesives layers of the two above-mentioned fire-resistant multilayer films were made to counter, after putting the conductor in which the circuit pattern was formed between the binder layers of these both, the laminating was carried out by thermal melting arrival using the lamination roll, and the flat cable with which the conductor was put between adhesives layers was produced. In addition, the conductor and lamination conditions which were used are as follows. Conductor: Copper foil with 0.12mm [ in thickness ] and a width of face of 3mm was installed at intervals of 1mm.

Lamination conditions: The temperature of 170 degrees C, the pressure of 6kg/cm<sup>2</sup>, and rate 0.5 m/min

[0065] A following performance test and a following performance evaluation were performed per the fire-resistant multilayer film obtained in the above-mentioned example and the example of a comparison, and flat cable, and the result was shown in tables 1 and 2.

(1) What did not carry out autolysis slaking of what carried out autolysis slaking of what made the sample the multilayer film with an inflammable trial width of face [ of 60mm ] and a die length of 150mm, and it



installed horizontally, and carried out autolysis slaking of this sample to the U character mold holder within 10 seconds when it was made to light, installation and within O and 20 seconds within O and 20 seconds was displayed as x.

[0066] (2) An electric characteristic test (electric resistance, withstand voltage)

After cutting down a flat cable so that it may become somewhat longer than 100mm, the conductor part of ends was exposed and the sample whose die length of a non-exposed part is 100mm was produced. About this sample, the electrical potential difference was impressed to the conductor part mutually located in an opposite hand, and the electric resistance between adjacent conductors was measured. Moreover, the withstand voltage test of 1kVx1min was performed by the same approach. In the above-mentioned trial, are more than electric resistance 103 Mohm of a between [ conductors ], and the thing without the poor electric conduction after a withstand voltage test was judged to be O, and the thing without that right was judged to be x.

[0067] (3) After heating a folding-proof trial flat cable at 100 degrees C by the condition of having bent thoroughly at 180 degrees for 120 hours, that to which O and poor electric conduction took place the thing without poor electric conduction was judged to be x.

[0068] (4) Adhesive strength test (it carries out only about examples 5-9 and the example 2 of a comparison)

It is attached to what pasted up the adhesives layers of a multilayer film, and is JIS. Based on Z-1526, heat-sealing bond strength was measured for the sample of 15mm width of face by T mold friction test at part 90 degrees C for 200mm/in tension rate, and O and a thing (1-2.5kg / 15mm) were judged for the thing exceeding the heat-sealing bond strength of 2.5kg / 15mm to be O. If heat-sealing bond strength is 1kg / 15mm or more, it has bond strength sufficient as a flat cable. In addition, the heat-sealing conditions are as follows.

Pressure: 2kg/cm<sup>2</sup>, temperature: 170 degree C, time amount: 1 second [0069]

[A table 1]

(重量部)

|                         |                    | 実 施 例        |              |              |              | 比較例          |
|-------------------------|--------------------|--------------|--------------|--------------|--------------|--------------|
|                         |                    | 1            | 2            | 3            | 4            | 1            |
| 基樹<br>材脂<br>組<br>成<br>物 | ポリブチレン<br>テレフタレート  | 100          | 100          | 100          | 100          | 100          |
|                         | 酸化防止剤              | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          |
| 接着剤用樹脂組成物               | 熱可塑性ポリエステル系樹脂 (種類) | 100<br>(A-1) | 100<br>(A-2) | 100<br>(A-3) | 100<br>(A-1) | 100<br>(A-1) |
|                         | 熱可塑性ポリエステル系エラストマー  | 30           | 30           | 30           | 30           | 30           |
|                         | デカブロモジフェニルエーテル     | 30           | 30           | 30           | —            | —            |
|                         | パークロロベンタシクロデカン     | —            | —            | —            | 30           | —            |
|                         | 三酸化アンチモン           | 20           | 20           | 20           | 20           | —            |
| 性能評価                    | 燃 焼 性              | ○            | ○            | ○            | ○            | ×            |
|                         | 電 気 特 性            | ○            | ○            | ○            | ○            | ○            |
|                         | 耐折り畳み性             | ○            | ○            | ○            | ○            | ○            |

[0070]

[A table 2]

(重量部)

|           |                         | 実 施 例        |              |              |              |              | 比較例          |
|-----------|-------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|           |                         | 5            | 6            | 7            | 8            | 9            | 2            |
| 基材用樹脂組成物  | ポリブチレン<br>テレフタレート       | 100          | 100          | 100          | 100          | 100          | 100          |
|           | 酸化防止剤                   | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          |
|           | デカブロモ<br>ジフェニルエーテル      | 30           | 30           | 30           | —            | —            | —            |
|           | パークロロベンタ<br>シクロデカン      | —            | —            | —            | 30           | —            | —            |
|           | 三酸化アンチモン                | 20           | 20           | 20           | 20           | —            | —            |
| 接着剤用樹脂組成物 | 熱可塑性ポリエステル<br>系樹脂 (種 類) | 100<br>(A-1) | 100<br>(A-2) | 100<br>(A-3) | 100<br>(A-1) | 100<br>(A-1) | 100<br>(A-1) |
|           | 熱可塑性ポリエステル<br>系エラストマー   | 30           | 30           | 30           | 30           | 30           | 30           |
|           | パークロロベンタ<br>シクロデカン      | —            | —            | —            | —            | 20           | —            |
|           | 三酸化アンチモン                | —            | —            | —            | —            | 15           | —            |
| 性能評価      | 接 着 強 度                 | ◎            | ◎            | ◎            | ◎            | ○            | ◎            |
|           | 燃 焼 性                   | ○            | ○            | ○            | ○            | ○            | ×            |
|           | 電 気 特 性                 | ○            | ○            | ○            | ○            | ○            | ○            |
|           | 耐折り畳み性                  | ○            | ○            | ○            | ○            | ○            | ○            |

[0071] (Examples 10-17 and examples 3 and 4 of a comparison) The resin constituent for base materials of the loadings shown in tables 3 and 4 and the resin constituent for adhesives of the loadings shown in tables 3 and 4 were co-extruded, on the base material of 100-micrometer thickness formed from the resin constituent for base materials, the laminating of the adhesives layer of 20-micrometer thickness was carried out, and the fire-resistant multilayer film was obtained. Subsequently, the above-mentioned fire-resistant multilayer film was used, and the flat cable with which the conductor was put was produced like the example 1.

[0072] A following performance test or a following performance evaluation was performed per the fire-resistant multilayer film obtained in the above-mentioned examples 10-17 and the examples 3 and 4 of a comparison, and flat cable, and the result was shown in tables 3 and 4. The performance test and the performance-evaluation item added the combustion gas trial of following (5) other than the (1) same flammability trial as an example 1, (2) electrical-and-electric-equipment characteristic test (electric resistance, withstand voltage), and a folding-proof [ (3) ] trial.

[0073] (5) Combustion gas trial JIS Combustion gas analysis was performed based on K7217, what generating of hydrogen halide was not detected as was made into O, and what was detected was made into x.

[0074]

[A table 3]

|                     |                    | (重量部)     |           |           |           |           |
|---------------------|--------------------|-----------|-----------|-----------|-----------|-----------|
|                     |                    | 実 施 例     |           |           |           |           |
|                     |                    | 10        | 11        | 12        | 13        | 14        |
| 基樹<br>材用<br>組成<br>物 | ポリブチレン<br>テレフタレート  | 100       | 100       | 100       | 100       | 100       |
|                     | 酸化防止剤              | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| 接着剤用樹脂組成物           | 熱可塑性ポリエステル系樹脂 (種類) | 100 (A-1) | 100 (A-2) | 100 (A-3) | 100 (A-1) | 100 (A-1) |
|                     | 熱可塑性ポリエステル系エラストマー  | 30        | 30        | 30        | 30        | 30        |
|                     | フェニルホスホン酸          | 40        | 40        | 40        | —         | —         |
|                     | t-ブチルホスホン酸         | —         | —         | —         | 40        | —         |
|                     | フェニルホスフィン酸         | —         | —         | —         | —         | 40        |
| 性能評価                | 燃 焼 性              | ○         | ○         | ○         | ○         | ○         |
|                     | 燃 焼 ガ ス            | ○         | ○         | ○         | ○         | ○         |
|                     | 電 気 特 性            | ○         | ○         | ○         | ○         | ○         |
|                     | 耐折り畳み性             | ○         | ○         | ○         | ○         | ○         |

[0075]

[A table 4]

|                     |                    | (重量部)     |           |           |           |           |
|---------------------|--------------------|-----------|-----------|-----------|-----------|-----------|
|                     |                    | 実 施 例     |           |           | 比 較 例     |           |
|                     |                    | 15        | 16        | 17        | 3         | 4         |
| 基樹<br>材用<br>組成<br>物 | ポリブチレン<br>テレフタレート  | 100       | 100       | 100       | 100       | 100       |
|                     | 酸化防止剤              | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| 接着剤用樹脂組成物           | 熱可塑性ポリエステル系樹脂 (種類) | 100 (A-1) | 100 (A-1) | 100 (A-1) | 100 (A-1) | 100 (A-1) |
|                     | 熱可塑性ポリエステル系エラストマー  | 30        | 30        | 30        | 30        | 30        |
|                     | ポリリン酸<br>アンモニウム    | 40        | 40        | 40        | —         | —         |
|                     | パークロロベンタ<br>シクロデカン | —         | —         | —         | —         | 40        |
|                     | 二酸化ケイ素             | —         | 5         | 5         | —         | —         |
|                     | カーボンブラック           | —         | —         | 5         | —         | —         |
| 性能評価                | 燃 焼 性              | ○         | ◎         | ◎         | ×         | ○         |
|                     | 燃 焼 ガ ス            | ○         | ○         | ○         | ○         | ×         |
|                     | 電 気 特 性            | ○         | ○         | ○         | ○         | ○         |
|                     | 耐折り畳み性             | ○         | ○         | ○         | ○         | ○         |

[0076] (Examples 18-26 and examples 5-7 of a comparison) The resin constituent for base materials of the loadings shown in tables 5 and 6 and the resin constituent for adhesives of the loadings shown in tables 5 and 6 were co-extruded, on the base material of 100-micrometer thickness formed from the resin constituent for base materials, the laminating of the adhesives layer of 20-micrometer thickness was carried out, and the fire-resistant multilayer film was obtained. Subsequently, the above-mentioned fire-resistant multilayer film was used, and the flat cable with which the conductor was put was produced like the example 1.

[0077] The performance test or the performance evaluation was performed per the fire-resistant multilayer film obtained in the above-mentioned examples 18-26 and the examples 5-7 of a comparison, and flat cable, and the result was shown in tables 5 and 6. The performance test and the performance-evaluation item were

considered as the (1) same flammability trial as the above, (2) electrical-and-electric-equipment characteristic test (electric resistance, withstand voltage), a folding-proof [ (3) ] trial, (4) adhesive strength tests, and (5) combustion gas trials.

[0078]

[A table 5]

(重量部)

|          |                    | 実 施 例        |              |              |              |              |              |
|----------|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|          |                    | 18           | 19           | 20           | 21           | 22           | 23           |
| 接着剤組成物   | 熱可塑性ポリエステル系樹脂 (種類) | 100<br>(A-1) | 100<br>(A-2) | 100<br>(A-3) | 100<br>(A-1) | 100<br>(A-1) | 100<br>(A-1) |
|          | 熱可塑性ポリエステル系エラストマー  | 30           | 30           | 30           | 30           | 30           | 30           |
| 基材用樹脂組成物 | ポリブチレンテレフタレート      | 100          | 100          | 100          | 100          | 100          | 100          |
|          | 酸化防止剤              | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          | 0.1          |
|          | フェニルホスホン酸          | 40           | 40           | 40           | —            | —            | —            |
|          | t-ブチルホスホン酸         | —            | —            | —            | 40           | —            | —            |
|          | フェニルホスフィン酸         | —            | —            | —            | —            | 40           | —            |
|          | ポリリン酸アンモニウム        | —            | —            | —            | —            | —            | 40           |
| 性能評価     | 燃 焼 性              | ○            | ○            | ○            | ○            | ○            | ○            |
|          | 燃 焼 ガ ス            | ○            | ○            | ○            | ○            | ○            | ○            |
|          | 電 気 特 性            | ○            | ○            | ○            | ○            | ○            | ○            |
|          | 耐折り畳み性             | ○            | ○            | ○            | ○            | ○            | ○            |
|          | 接 着 強 度            | ○            | ○            | ○            | ○            | ○            | ○            |

[0079]

[A table 6]

(重量部)

|          |                    | 実 施 例     |           |           | 比 較 例     |           |           |
|----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|          |                    | 24        | 25        | 26        | 5         | 6         | 7         |
| 接着剤用組成物  | 熱可塑性ポリエステル系樹脂 (種類) | 100 (A-1) | 100 (A-1) | 100 (A-1) | 100 (A-1) | 100 (A-1) | 100 (A-1) |
|          | 熱可塑性ポリエステル系エラストマー  | 30        | 30        | 30        | 30        | 30        | 30        |
|          | ポリリン酸アンモニウム        | —         | —         | —         | —         | —         | 40        |
| 基材用樹脂組成物 | ポリブチレンテレフタレート      | 100       | 100       | 100       | 100       | 100       | 100       |
|          | 酸化防止剤              | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
|          | ポリリン酸アンモニウム        | 100       | 40        | 40        | —         | —         | —         |
|          | パークロロベンタシクロデカン     | —         | —         | —         | —         | 40        | —         |
|          | 二酸化ケイ素             | —         | 5         | 5         | —         | —         | —         |
|          | カーボンブラック           | —         | —         | 5         | —         | —         | —         |
| 性能評価     | 燃 焼 性              | ○         | ◎         | ◎         | ×         | ○         | ○         |
|          | 燃 焼 ガ ス            | ○         | ○         | ○         | ○         | ×         | ○         |
|          | 電 気 特 性            | ○         | ○         | ○         | ○         | ○         | ○         |
|          | 耐折り畳み性             | ○         | ○         | ○         | ○         | ○         | ○         |
|          | 接 着 強 度            | ○         | ○         | ○         | ○         | ○         | ×         |

[0080] (Examples 27-33) The resin constituent for base materials of the loadings shown in tables 7 and 8 and the resin constituent for adhesives of the loadings shown in tables 7 and 8 were co-extruded, on the base material of 100-micrometer thickness formed from the resin constituent for base materials, the laminating of the adhesives layer of 20-micrometer thickness was carried out, and the fire-resistant multilayer film was obtained. Subsequently, the above-mentioned fire-resistant multilayer film was used, and the flat cable with which the conductor was put was produced like the example 1.

[0081] The performance test or the performance evaluation was performed per the fire-resistant multilayer film obtained in the above-mentioned examples 27-33, and flat cable, and the result was shown in tables 7 and 8. a performance test -- and -- a performance evaluation -- an item -- the above -- being the same -- (-- two --) -- the electrical and electric equipment -- a characteristic test (electric resistance, withstand voltage) -- (-- three --) -- -proof -- folding -- a trial -- (-- four --) -- an adhesive strength test -- and -- the following -- (- six --) -- a water resisting property -- a trial (\*\*\*\* ductility) -- \*\* -- having carried out .

[0082] (6) A waterproof trial (\*\*\*\* ductility)

The fire-resistant multilayer film was immersed for ten days into 95-degree C hot water, the \*\*\*\* ductility before and behind immersion was measured, retention = (\*\*\*\* ductility before the \*\*\*\* ductility / immersion after immersion) was computed from measured value, and retention made O and less than 0.70 thing x for 0.70 or more things.

[0083]

[A table 7]

(重量部)

|   |                         | 実 施 例        |              |              |              |
|---|-------------------------|--------------|--------------|--------------|--------------|
|   |                         | 27           | 28           | 29           | 30           |
| 基<br>材<br>用<br>樹<br>脂<br>組<br>成<br>物      | ポリブチレン<br>テレフタレート       | 100          | 100          | 100          | 100          |
|   | エチレン・エチルア<br>クリレート共重合体  | 10           | 10           | 10           | —            |
|   | ポリカルボジイミド               | 1            | 1            | 1            | —            |
|   | 酸化防止剤                   | 0.1          | 0.1          | 0.1          | 0.1          |
|   | ポリリン酸<br>アンモニウム         | 40           | —            | —            | 40           |
|   | t-ブチル<br>ホスフィン酸         | —            | 40           | —            | —            |
|   | フェニル<br>ホスフィン酸          | —            | —            | 40           | —            |
| 接<br>着<br>剤<br>用<br>樹<br>脂<br>組<br>成<br>物 | ポリオレフィン系<br>樹脂 (種 類)    | 100<br>(B-1) | 100<br>(B-1) | —            | 100<br>(B-1) |
|   | 熱可塑性ポリエステル<br>系樹脂 (種 類) | 20<br>(A-1)  | —            | 100<br>(A-1) | 20<br>(A-1)  |
|   | 熱可塑性ポリエステル<br>系エラストマー   | 6            | —            | 30           | 6            |
|   | ポリリン酸<br>アンモニウム         | —            | 40           | 40           | —            |
|   | 二酸化ケイ素                  | —            | 5            | —            | —            |
| 性<br>能<br>評<br>価                          | 接 着 強 度                 | ○            | ○            | ○            | ○            |
|   | 電 気 特 性                 | ○            | ○            | ○            | ○            |
|   | 耐折り畳み性                  | ○            | ○            | ○            | ○            |
|   | 耐水性 (引張伸度)              | ○            | ○            | ○            | ○            |

[0084]

[A table 8]



(重量部)

|           |                        | 実 施 例        |              |              |
|-----------|------------------------|--------------|--------------|--------------|
|           |                        | 31           | 32           | 33           |
| 基材用樹脂組成物  | ポリブチレン<br>テレフタレート      | 100          | 100          | 100          |
|           | エチレン・エチルア<br>クリレート共重合体 | —            | 10           | 10           |
|           | ポリカルボジイミド              | —            | 1            | 1            |
|           | 酸化防止剤                  | 0.1          | 0.1          | 0.1          |
|           | ポリリン酸<br>アンモニウム        | —            | —            | 40           |
|           | デカブロモ<br>ジフェニルエーテル     | —            | 30           | —            |
|           | 三酸化アンチモン               | —            | 20           | —            |
| 接着剤用樹脂組成物 | ポリオレフィン系<br>樹脂 (種 類)   | 100<br>(B-1) | 100<br>(B-2) | 100<br>(B-3) |
|           | 熱可塑性ポリエステル系樹脂 (種 類)    | 20<br>(A-1)  | 20<br>(A-1)  | 20<br>(A-1)  |
|           | 熱可塑性ポリエステル系エラストマー      | 6            | —            | 30           |
|           | ポリリン酸<br>アンモニウム        | 40           | —            | —            |
|           | カーボンブラック               | 5            | —            | —            |
|           | デカブロモ<br>ジフェニルエーテル     | —            | 30           | —            |
|           | 三酸化アンチモン               | —            | 20           | —            |
| 性能評価      | 接 着 強 度                | ○            | ○            | ○            |
|           | 電 気 特 性                | ○            | ○            | ○            |
|           | 耐折り畳み性                 | ○            | ○            | ○            |
|           | 耐水性 (引張伸度)             | ○            | ○            | ○            |

[0085] The following component was used among the table. The component with the same said of the following examples and examples of a comparison was used.

- polybutylene terephthalate: -- intrinsic viscosity (I. V.) -- =1.0 (measurement among [ of 25 degrees C ] o-chlorophenol)

- Anti-oxidant : "IRGANOX B-225" by Ciba-Geigy

- polyolefine system resin (B-1): -- "REKUSU pearl ET183B" by the Japanese polyolefine company, the "REKUSU pearl RA 3150" by the melting point of 83 degrees C, and the polyolefine system resin (B-2):Japan polyolefine company, the "Nippon Oil N polymer A1600" by the melting point of 100 degrees C, and the polyolefine system resin (B-3):Japan polyolefine company, and the melting point [0086] of 93 degrees C - Ethylene-ethyl acrylate copolymer : "EER-BRT -490" by Nippon Unicar

- Poly carbodiimide : "SUTAPAKUZORU PCD" by the Hiraizumi traveling-abroad company

[0087] - t-butyl phosphonic acid: - phenyl phosphinic acid [ by the Wako Pure Chem industrial company ]: - ammonium polyphosphate [ by the Wako Pure Chem industrial company ]: -- "AP-462" by Hoechst A.G.

- silicon-dioxide: -- the Dohkai Chemical industries Co., Ltd. make -- "-- sill DEKKUSU H-51"

- Carbon black : "MA-100" by Mitsubishi Chemical

- Decabromodiphenyl ether : Wako Pure Chem industrial company make [0088]

[Effect of the Invention] Since a good adhesive property and the fire retardancy which was excellent with the electrical property are given by considering the fire-resistant multilayer film of this invention as an above-mentioned configuration, the flat cable using it is used suitable for broad applications, such as automobile lumber and housing lumber.

[Translation done.]